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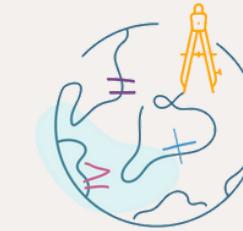
# Itinerary



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# VisitMath Warsaw Royal Route





Welcome to Warsaw, the capital of Poland! I am the Golden Duck, the heroine of one of Warsaw's legends. I was once a princess, but I've been turned into a duck! Come with me, and I'll show you how beautiful my city is. If you solve all of these problems correctly, I will return to my true form. My fate is in your hands! But don't worry, I'll help you along the way.

Our tour begins with a visit to my dear friend - the Warsaw Mermaid. We both like water very much.

### Step 1: The Old Town Warsaw Mermaid Monument

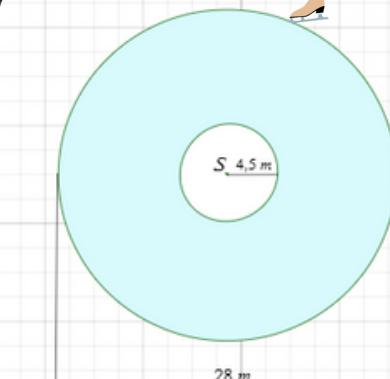


The statue was created in the 19th century alongside the first modern waterwork system in Warsaw. The artist, Konstanty Hegl, portrayed the mermaid emerging from the waves, holding a sword and shield. These battle symbols represent the protective role of the city, as well as the Mermaid's protection over it. Her fish tail shows her connection to the Vistula River. The Mermaid also appears in the city's coat of arms.

The most magical city ice rink is located in the Old Town Square. It has the form of a circle with a diameter of 28 m, with a circle cut inside with a radius of 4.5 m, in which there is a monument to the Mermaid.



How many liters of water must be poured onto the ice rink to make the surface 7 cm thick?  
For calculations, assume  $\pi=3.14$ .



Hint!

The formula for the area of a circle:  
and the volume:  $V = \text{base area} \times \text{height}$ .

$$P = \pi r^2$$

This will also be useful!

$$1L = 1dm^3 = 10^{-3}m^3$$



We go to a point, which is situated on the trail called the Royal Route.

## Step 2: Church of the Visitation Sisters



Part of the church's history is the person of Frédéric Chopin, who in 1825-1826, as a student at the Warsaw Lyceum, played the church organ during Sunday masses for high school students.

The convent church of the Visitation Sisters is one of the few Warsaw monuments that was not destroyed during World War II. With its sculptural facade, the church is one of the most beautiful buildings in Warsaw and one of the most magnificent works of sacred Baroque architecture in Poland.



Next to the church is one of 15 multimedia Chopin benches. Walking around Warsaw, you can sit on the bench of your choice and, at the push of a button, listen to one of Chopin's works.

From the description on the bench, you can find out why the bench is located in front of a particular building or structure and what its connection to the composer was, and thanks to QR codes, you can download an app containing an audio guide to Chopin. In addition, there is a map on the seat showing where to find the next benches.



Next to the bench I met my old friends Anna, Maria, Karol, Marek and Jan, who were listening to Chopin's music.



Anna and Maria are twins. The arithmetic mean of the ages of Karol, Marek and Jan is 21. The arithmetic sum of the ages of all five of my friends is 97. Calculate how old the sisters are.



Congratulations for solving the task so quickly!  
And now we're off to the next spot, which is at 46/48 Krakowskie Przedmieście.

### Step 3: The Presidential Palace

Krakowskie Przedmieście 46/48 is the address of the Presidential Palace, which is the largest palace in Warsaw. It consists of a four-story main body and two two-story side wings. This is where the President of Poland holds office.



The palace was built in the 1740s.

After Poland regained its independence in 1918, it became the seat of the Prime Minister and the side wings were occupied by the offices of the Chancellery of the Council of Ministers. During the occupation, the palace was converted into a luxury hotel with a casino. After the end of the Second World War it became the seat of the Prime Minister and the Council of Ministers.

In 1994 it became the official seat of the President of Poland and has since been called the Presidential Palace.



On one of the palace's roof surfaces, roof tiles are arranged in sixteen rows. The lowest row consists of 120 roof tiles, and in each next (higher) row there are 4 fewer roof tiles than in the previous (lower) row.

How many roof tiles are there in the last row?

How many roof tiles are on this roof surface?

#### Hint!

Use the properties of an arithmetic sequence.

Arithmetic progression - a sequence of numbers such that the difference ( $r$ ) of any two successive members of the sequence is a constant.



$$a_n = a_1 + (n - 1) * r$$

$$S_n = \frac{a_1 + a_n}{2} * n$$

$S_n$  - the sum of the  $n$  - initial terms of an arithmetic sequence

$a_1$  - the first term of the sequence

$a_n$  - the last term of the sequence



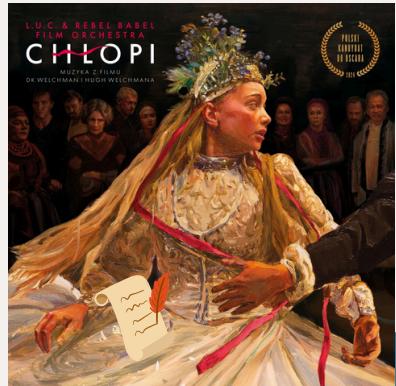
#### Problem solved!

Now I will take you to a very important place, not just for Warsaw residents, called the heart of the Capital.

## Step 4: The Basilica of the Holy Cross



The large classicist temple is known for its figure of Christ leaning under the cross at the top of the stairs. The monumental interior contains urns with the hearts of Fryderyk Chopin and Władysław Reymont.



Władysław Reymont (1867 – 1925) was a Polish writer. His most known novel, "Peasants" („Chłopi”), won him the Nobel Prize. Lately it has been adapted for the big screen as an oil-painted animation.



Traditionally, during the International Chopin Piano Competition on October 17 - the day of Fryderyk Chopin's death - a ceremonial Holy Mass is celebrated in the church, during which, in accordance with the composer's wishes, Wolfgang Amadeus Mozart's Requiem is performed.



Calculate the measure of the angle of inclination of the stairs.

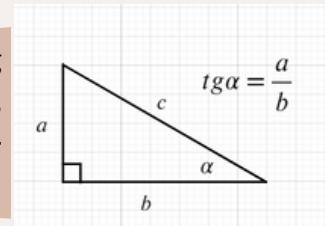


The figure you see in the photo is an isosceles trapezoid. It is worth noting that this trapezoid contains a right triangle, its one of the angles is  $\alpha$ . Calculate the length of the leg (a).

Use the information provided:

- number of steps: 14
- height of one step: 18 cm

You can calculate the second leg (b) using the properties of an isosceles trapezoid, its longer base is 35 m long and the shorter one is 25 m long.



Now it's time to calculate the tangent of angle  $\alpha$ .  
Let me remind you its definition:



The tangent of an acute angle in a right triangle is the ratio (quotient) of the length of the leg opposite the angle to the length of the leg adjacent to the angle.

I have prepared a fragment of the trigonometric tables for you. Read the measure of the angle from them.



| $\alpha$ | $\sin \alpha$ | $\cos \alpha$ | $\tg \alpha$ |
|----------|---------------|---------------|--------------|
| 20°      | 0,3420        | 0,9397        | 0,3640       |
| 21°      | 0,3584        | 0,9336        | 0,3839       |
| 22°      | 0,3746        | 0,9272        | 0,4040       |
| 23°      | 0,3907        | 0,9205        | 0,4245       |
| 24°      | 0,4067        | 0,9135        | 0,4452       |
| 25°      | 0,4226        | 0,9063        | 0,4663       |
| 26°      | 0,4384        | 0,8988        | 0,4877       |
| 27°      | 0,4540        | 0,8910        | 0,5095       |
| 28°      | 0,4695        | 0,8829        | 0,5317       |
| 29°      | 0,4848        | 0,8746        | 0,5543       |
| 30°      | 0,5000        | 0,8660        | 0,5774       |

Phew! That was difficult! But you did it!  
I'm so proud of you!



We are located on Krakowskie Przedmieście - one of the most beautiful streets in Warsaw. There are many beautiful houses, churches and monuments here. One of them is dedicated to Nicolaus Copernicus (1473-1543), the great astronomer and creator of the heliocentric model of the Earth. That's where we're going now.

## Step 5: Copernicus Monument

Copernicus sits on a high chair and at his feet the planets spin in their orbits.



My friend Marta wants to check the scale in which her favorite planet, Venus, was represented. She measured its diameter using shoes. It turned out to be two times the length of her shoe. Marta's shoe is 23 cm long, and the radius of Venus is 6051.8 km. Help Marta finish the task.



Remember to convert the units!



Marta

## Step 6: University of Warsaw

We enter through a beautiful gate into the University Campus.



The university was established in 1816 under the name of the Royal University of Warsaw. It is the largest, best and one of the oldest universities in Poland. At the time of its establishment, the University consisted of five faculties: Law, Medicine, Philosophy, Theology and Sciences and Fine Arts. Currently, the number of faculties has increased to 25.



The university campus consists of many beautiful buildings. One of them is the Old Library. In 1820, a bookworm took up residence in one of the books on the lowest shelf. He also liked the book next to it. He chewed through both books from the first page of the first book to the last page of the second.



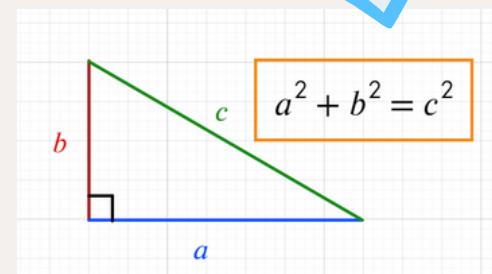
Calculate the length of the moth-eaten tunnel if the thickness of all pages of each volume is 3 cm, and each cover is 2 mm. We assume that the pest has drilled the shortest possible tunnel.



**Way to go!**  
**You solved this task quickly!**

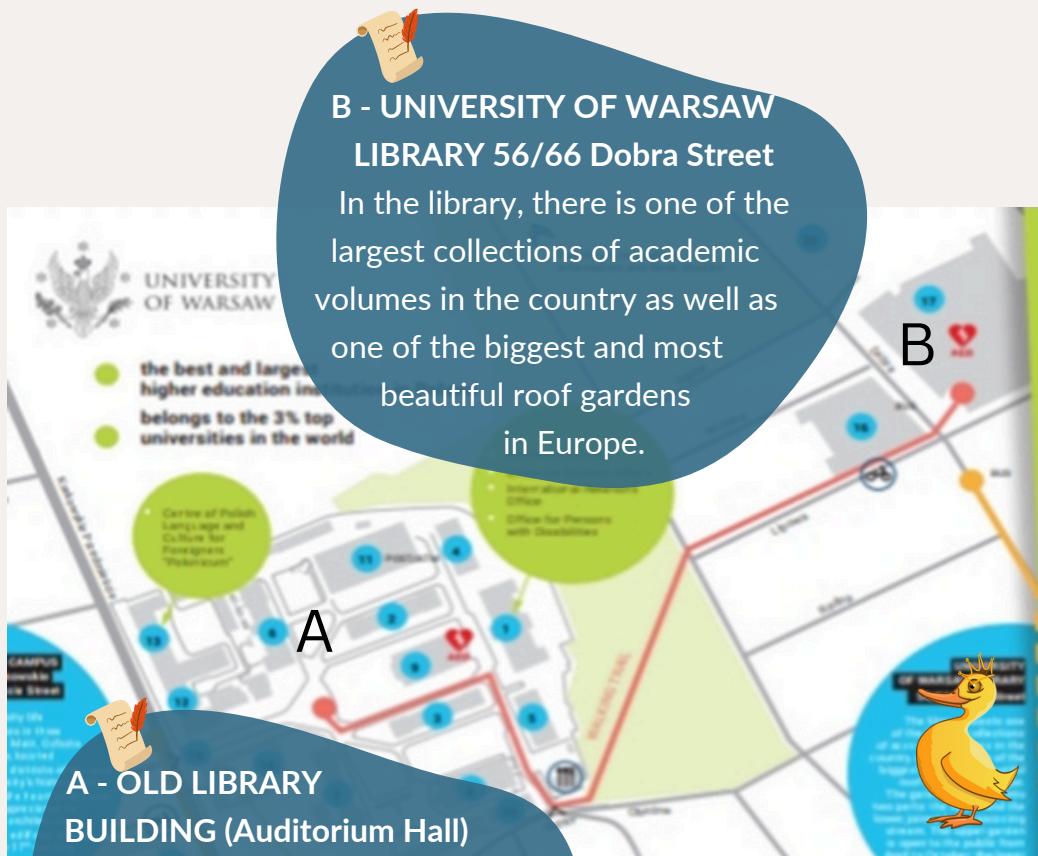


**Get ready!**  
In the next task  
you'll need the  
Pythagorean theorem.



## Step 7: University of Warsaw Library

Students often follow the route (marked in red on the map) between the Old Library (point A) and the New Library (point B).



**A - OLD LIBRARY BUILDING (Auditorium Hall)**  
During World War II, Czesław Miłosz, a student of the University (in 1932), who was later to win a Nobel Prize for Literature (1980), worked at the Old Library as a caretaker.

**B - UNIVERSITY OF WARSAW LIBRARY 56/66 Dobra Street**  
In the library, there is one of the largest collections of academic volumes in the country as well as one of the biggest and most beautiful roof gardens in Europe.

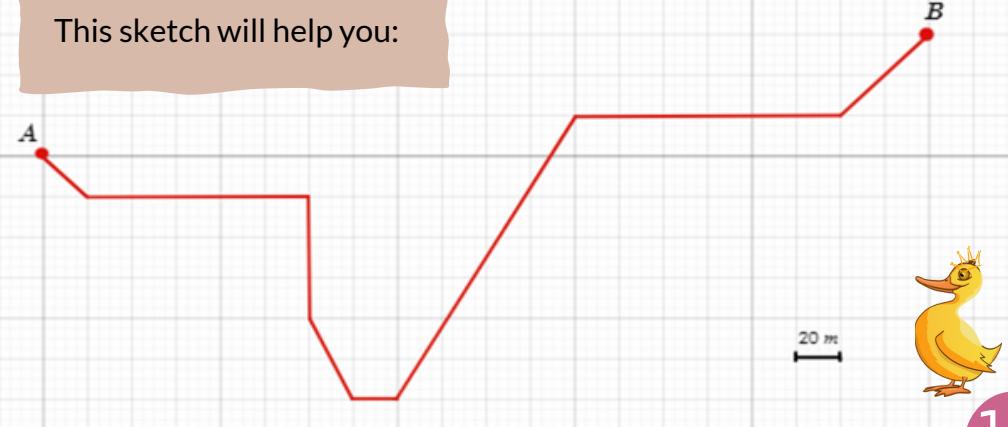


The garden is divided into two parts: the upper and the lower, joined by a cascading stream. The upper garden is open to the public from April to October; the lower garden is open all year round.



Calculate the length of the path the student must travel from the Old Library to the New Library.  
Give the result with an accuracy of 1 meter.

This sketch will help you:





Phew! That was hard! But you did it!  
The last step is ahead of us!



## Step 8: Golden Duck Monument



### 37 Tamka Street

The placement of this statue is not accidental. The old legend says that somewhere in this area a princess turned into a duck hides. When found, she will grant her saviour a great treasure.



Solve this task and you will find out how many gold coins there are in my chest. If you guess the number of coins, you will reverse the spell that was put on me!



The number of gold coins is a three-digit number. The units digit in it is 2. If we move 2 to the hundreds column, then move the hundreds digit to the tens column and the tens digit to the units column, we will get a number larger than the original number by one third. What is the original number of coins?



#### Hint #1:

If you denote  $x$  as the hundreds digit and  $y$  as the tens digit, the number will look like this:

$$100x + 10y + 2$$

#### Hint #2:

The number with the digits rearranged looks like this:

$$2 \times 100 + 10x + y$$

Congratulations! You managed to solve all the tasks correctly. Thanks to you, I have returned to my original form.

Thank you!

